Level Density Corrections for Missing and Spurious Levels

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Nuclear level densities are crucial for the calculation of reaction rates and cross sections. Experimental data obtained by direct counting methods are from low-lying discrete levels and from compound nuclear resonances. A key difficulty is that the experiments are never perfect — some levels are not observed and some quantum numbers are misassigned. These are called the missing level and spurious level problems.

For the missing level problem, the standard approach assumes that the underlying distribution is a Porter-Thomas distribution and that the weakest levels are missed. A new approach is based on the measured spacing distributions. Using the principle of maximum entropy, we have obtained a probability distribution for imperfect eigenvalue sequences. The method used to determine the fraction of missing levels is described in a recent paper [1].

For the spurious level problem we use the most striking characteristic of the spacing distribution: level repulsion. The existence of very small spacings is a signature of misassignment. If an experimental data set has a mixture of states with different quantum numbers, the degree of mixing is reflected in the disappearance of the level repulsion. Extrapolation of the probability distribution to zero spacing provides an estimate of the relative size of the states with different symmetries.

[1] U. Agvaanluvsan, G. E. Mitchell, J. F. Shriner, Jr. , M. Pato, Phys. Rev. C **67** 064608 (2003)

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